

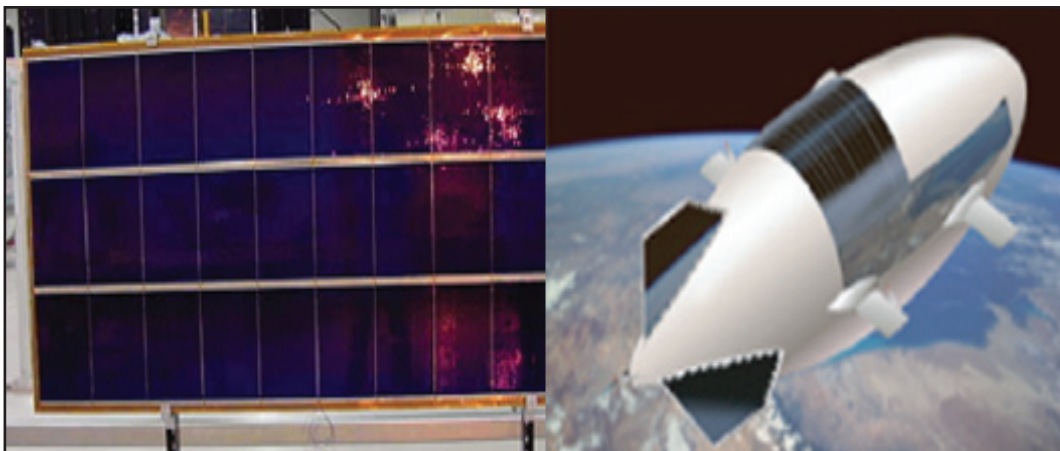


Air Force Research Laboratory|AFRL

Science and Technology for Tomorrow's Air and Space Force

SUCCESS STORY

AFRL TRANSITIONS THIN-FILM SOLAR CELLS



The Missile Defense Agency (MDA) selected AFRL's thin-film solar cell technology to meet the power generation requirements of its High-Altitude Airship (HAA) Advanced Concept Technology Demonstration program. The MDA will demonstrate the laboratory-developed technology in the deployed structures experiment (DSX), which will establish the viability of thin-film solar arrays and deployment mechanisms while increasing technical maturity. The DSX will also demonstrate a lightweight rollout array >200 W/kg. The array will contain solar cells from at least three different vendors and will include experiments on protective coatings for thin-film solar cells, high-voltage solar modules, and high-temperature annealing.



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Accomplishment

AFRL developed thin-film solar cell technology under several contracts designed to transition the cells from terrestrial to space-based applications. The work targeted the adaptation of thin-film solar cells from heavy, rigid substrates (e.g., glass) to flexible, lightweight substrates (e.g., stainless steel and polymer foils). Additional work focused on modifying the cells to withstand the extreme space environment and increasing their efficiency in the blue-light-rich space solar spectrum. When paired with a lightweight support structure, thin-film solar cells produce satellite solar arrays that are 4 times less expensive and have 7 times higher specific power, 10 times greater stowed volume, and better radiation resistance than state-of-the-art rigid panel solar arrays that use crystalline multijunction solar cells.

Thin-film solar cells are the only technology capable of meeting the HAA's high specific power requirements (>750 W/kg) without the use of fragile, brittle crystalline silicon or crystalline multijunction solar cells. The low mass of HAA thin-film solar arrays reduces the volume of lifting gas as well as the HAA's size, since each additional pound allocated to the solar array requires hundreds of additional cubic feet of lifting gas. As a result, scientists identified thin-film solar cell technology as a leading candidate for the HAA.

Background

Scientists are developing thin-film solar cell technologies for space and the HAA. They fabricate the cells using amorphous silicon or polycrystalline copper-indium-gallium-diselenide materials. These solar cells have lower efficiencies than state-of-the-art crystalline multijunction solar cells, but their flexible, lightweight nature allows them to grow on 1 mil thick metal foils or polymer substrates.

Extensive testing is under way to space-qualify the technology at both the cell level and the module level, and scientists will complete this space qualification testing before constructing the flight hardware. Researchers will use ground radiation testing of thin-film solar cells to develop predictive models of radiation degradation. They will validate the resulting models through comparisons to on-orbit current and voltage data. Thin-film solar arrays are the next generation of power technology that will enable satellites by reducing the mass, stowed volume, and cost requirements for solar arrays. Increased solar array radiation resistance will allow easier access to high-radiation orbits.

Additional Information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (VS-S-05-03)

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